



Fermilab

Directorate

**MEMORANDUM OF UNDERSTANDING
FOR THE 2003-4 MESON TEST BEAM PROGRAM**

T935

BTeV RICH Detector Test Beam Run

May 30, 2003

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E918 (BTeV) is an approved experiment. It requires detector research and development in tracking, triggering, data acquisition, charged hadron identification (RICH), electromagnetic calorimetry and muon detection, as well as an extensive effort in simulation and software development. The goal of the present R&D project is to develop the final devices for use in the BTeV experiment. This MOU relates to RICH detector tests, which will be carried out using the MTEST beam of the Meson Area during the 2003-2004 run period.

This is a memorandum of understanding between the Fermi National Accelerator Laboratory and those experimenters of E918 who have committed to participate in RICH beam tests to be carried out during the 2003-2004 period. The memorandum is intended solely for the purpose of providing a budget estimate and a work allocation for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to negotiate amendments to this memorandum that will reflect such required adjustments.

I. Personnel and Institutions

BTeV RICH Test Beam Spokesperson:	Marina Artuso, Syracuse University
Physicist in Charge:	Ray Mountain, Syracuse University
E918 Test Beam Liaison:	Charles Newsom, University of Iowa
E918 Computing Off-line liaison:	Tomasz Skwarnicki, Syracuse University
E918 Computing On-line liaison:	Jianchun Wang, Syracuse University
Fermilab liaison physicist:	Erik Ramberg
Beamline physicist:	From Beams Div./External Beams Dept. Currently, Tom Kobilarcik
Particle Physics Division Liaison:	Erik Ramberg
Computing Division Liaison:	Dave Slimmer

The Collaboration members at present are:

- 1.1 Syracuse University: M. Artuso, S. Blusk, C. Boulahouache, J. Butt, O. Dorjkhaidav, J. Haynes, N. Menaa, R. Mountain, H. Muramatsu, R. Nadakumar, L. Redjimi, T. Skwarnicki, R. Sia, S. Stone, J. C. Wang, K. Zhang
- 1.2 Fermilab: H. Cease

Other commitments:

CLEO analysis: M. Artuso, S. Blusk, C. Boulahouace, J. Butt, O. Dorjkhaidav, J. Haynes, N. Menaa, R. Mountain, H. Muramatsu, R. Nadakumar, L. Redjimi, T. Skwarnicki, R. Sia, S. Stone, J. C. Wang, K. Zhang

Other Engineering Tasks: H. Cease

II. Experimental Area, Beams, and Schedule Considerations

2.1 LOCATION AND FACILITIES

- 2.1.1 The test apparatus is to be located in the downstream open area (MT6B) in the MTEST beam line roughly 5-7 meters upstream of the MT6B beam stop. Approximately 12 feet along the beam direction are required. In addition, the test-beam Control/Counting Room to the west of the MTEST beam will be used to house electronics.
- 2.1.2 A “gateway” computer with Internet access should be provided. Powered racks for electronics and NIM bins should also be made generally available.
- 2.1.3 The RICH tank is approximately 3 m long and will be surveyed by Herman Cease so that it is centered on the beam.
- 2.1.4 Space in cable trays for approximately 20 cables (4 high voltage and 20 ribbon readout cables connecting the MT6B to the Counting Room) is required.
- 2.1.5 The power requirements are 2 KW of clean power for electronics.
- 2.1.6 Space in electronics racks is needed in MT6B and the Counting Room. We require 30 vertical inches of rack space in each area.
- 2.1.7 One standard-size table will be required in the test-beam Counting Room. Computer networking to the gateway computer will be required at the table.
- 2.1.8 The RICH tank will be supplied with C_4F_{10} gas. The gas will be recirculated and cleaned in a system designed and constructed under the direction of H. Cease by the Fermilab PPD division.
- 2.1.9 We will need the use of the existing 1 mm XX’YY’ beam wire chamber for tracking. In addition we require 3 new 1 mm XYUV chambers. We will use these for tracking both upstream and downstream of the RICH tank.

2.2 BEAM

- 2.2.1 The tests will use slow resonantly-extracted, Main Injector proton beam focused onto the MTest target. The tests require a beam of untagged, charged particles of momentum 80 GeV/c or higher.
- 2.2.2 Intensity: Variable, in the range of 10 - 10^4 Hz.

2.3 SCHEDULE

The goal is to deliver charged particles at the rate stated above for data taking as required by the R&D program over a significant period beginning in Fall 2003. The group expects to run sporadically for about 1 month. The group expects to share beam time with other R&D efforts. Details are given in the section below labeled Run Plan.

III. Responsibilities by Collaboration Physics Group

([] denotes replacement cost of existing hardware.)

3.1 Syracuse University

Physicists will participate in the preparation and data taking phases of the test beam run.

3.1.1	Travel for personnel:	\$ 8 K
3.1.2	Test Beam Box:	\$25 K
3.1.3	Hybrid Photodiodes	\$55 K
3.1.4	Electronic Readout	\$40 K
3.1.5	Mirror	\$ 5 K
3.1.6	DAQ computer	\$ 2 K
3.1.7	DAQ Infrastructure (PTA Cards, Mezzanine Cards)	\$13 K
3.1.8	MAPMT	\$ 2K
Total existing items		[\$142 K]
Total new equipment items		0
Total operating cost		\$8 K

3.2 Fermilab

Engineers will participate in the preparation and data taking phases of the test beam run.

3.2.1 Gas System set up and C₄F₁₀ supply

Total existing items	[\$10K]
Total new equipment items	\$ 10 K
Total operating cost	\$ 0 K

The new equipment includes components for the gas recirculation system that need to be purchased, molecular sieve to remove particulate and water vapor and slow control items.

3.S Summaries of Section 3

3.S.1 Summary of Collaboration Responsibilities

Test beam coordination – Syracuse

Mechanical support and gas recirculation system – Fermilab

Trigger – Syracuse

Data Acquisition – Syracuse

Monitoring and Event Display – Syracuse

Offline Software (including data bases, run log, and web: development, maintenance) – Syracuse

3.S.2 Summary of Non-Fermilab Costs

	Equipment	Operating
Total existing items	[\$ 142 K]	
Total new items	\$ 0 K	\$ 8 K

IV. Responsibilities by Fermilab Division

([] denotes replacement cost of existing hardware.)

4.1 Fermilab Beams Division

- 4.1.1 Use of MTest beam line.
- 4.1.2 Maintenance of all existing standard beam-line elements (such as SWICs, loss monitors, remotely-controlled finger counters, etc), instrumentation, controls, clock distribution and power supplies.
- 4.1.3 Reasonably rapid access to our equipment in the test beam. Logic signal at experimenter electronics racks that has a constant phase (within 1-2 ns in a given hour) with respect to the arrival of beam buckets at the test apparatus.
- 4.1.4 No experiment-owned devices need interfacing to the Beams Division control system, other than the possible readout of beam-line variables.
- 4.1.5 The energy, position and focus of the test beam will be under the control of the Beam Division's Main Control Room. Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.
- 4.1.6 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.

4.1.S Summary of Beams Division costs:

	Equipment	Operating	Personnel (person-weeks)
Total new items	\$ 0 K	\$ 0 K	0
Total	\$ 0 K	\$ 0 K	0

4.2 Fermilab Particle Physics Division

The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section 2. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including use of the user beam-line controls, readout of the beam-line detectors, and MTest gateway computer. In addition, they will design and assemble the gas recirculation system, introduced in section 3.2.1. Costs under this section will be funded from BTeV accounts.

- 4.2.1 Use of the gateway UNIX computer for interfacing and isolation of DA computers.
- 4.2.2 Installation of quiet power (see Section 2.1.6) to detector enclosure if required to reduce noise in electronics. Provision of adequate air-conditioning and cooling for detectors and electronics in the beam area, the electronics alcove, and the counting room.
- 4.2.3 Provision of adequate moisture protection for equipment and personnel in MTest beam area and counting room.
- 4.2.4 Survey of RICH detector box on beam line and trigger counters.
- 4.2.5 Miscellaneous plumbing components in gas recirculation system 2.4K
- 4.2.6 General Supplies 1.0K
- 4.2.7 C₄F₁₀ gas 2.1K
- 4.2.8 Instrumentation for gas recirculating system 4.5K
- 4.2.9 Miscellaneous components of gas system [10K]
- 4.2.10 3 XYUV Fenker chambers [4.8K]

4.2.S Summary of Particle Physics Division costs:

	Equipment	Operating	Personnel (person-weeks)
Total existing items	\$0K	\$ 14.8K	
Total new items	\$0K	\$ 10K	4
Totals	\$0K	\$ 24.8K	4

4.3 Fermilab Computing Division

- 4.3.1 The Online Liaison from the Computing Division is Dave Slimmer.
- 4.3.2 The experimenters will write all necessary offline software and do not require Computing Division support.
- 4.3.3 Support is required from the Computing and Engineering for Physics Applications department (CD-CEPA) in developing and implementing the DAQ/On-line system for the RICH detector tests. Some mentoring from a CD computing professional familiar with the system might be necessary. This might involve 10% of an FTE for a short period of time. Some off-hour consulting support may be required for efficient use of beam-time, but 24x7 support is not required. Details of the support will be worked out among CD, PPD and the experiment.
- 4.3.4 Computer security for the RICH system in MTest will be organized by having the DA computers connect to the Meson Test Facility gateway computer. Any kerberized systems this experiment uses can be directly attached to the networking backbone.
- 4.3.5 Support during normal workday hours is required for the networking in MTest, including access to a gateway computer and local networking between the gateway and DA computer(s), which will not have network access.

4.3.S Summary of Computing Division Costs:

Type of Funds	Equipment	Operating	Personnel (person-weeks)
Total existing items	0		
Total new items	1K	0	1
Totals	1K	0	1

4.S Summary of Fermilab costs

Type of Funds [] denotes existing	Equipment	Operating	Personnel (person-weeks)
Beams Division	0	0	0
Particle Physics Division	10K	0	1
Computing Division	1K	0	1
Total existing items	[10K]	0	0
Total new items	11K	0	0

V. SPECIAL CONSIDERATIONS

- 5.1 The responsibilities of the BTeV RICH Test Beam Spokesperson and procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters" (PFX). The Physicist in charge agrees to those responsibilities and to follow the described procedures.
- 5.2 To carry out the experiment a number of Environmental, Safety and Health (ES&H) reviews are necessary. This includes creating a Partial Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The BTeV RICH Test Beam Spokesperson will follow those procedures in a timely manner, as well as any other requirements put forth by the division's safety officer.
- 5.3 The BTeV RICH Test Beam Spokesperson will ensure that at least one person is present at the Meson Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.
- 5.4 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.
- 5.5 All items in the Fermilab Policy on Computing will be followed by experimenters.
- 5.6 The BTeV RICH Test Beam Spokesperson will undertake to ensure that no PREP and computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.
- 5.7 Each institution will be responsible for maintaining and repairing both the electronics and the computing hardware supplied by them for the experiment. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.
- 5.8 If the experiment brings to Fermilab on-line data acquisition or data communications equipment to be integrated with Fermilab owned equipment, early consultation with the Computing Division is advised.
- 5.9 At the completion of the experiment:
- 5.9.1 The BTeV RICH Test Beam Spokesperson is responsible for the return of all PREP equipment, Computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the BTeV RICH Test Beam Spokesperson will be required to furnish, in writing, an explanation for any non-return.
- 5.9.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters.
- 5.9.3 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied, including computer printout and magnetic tapes.
- 5.9.4 An experimenter will report on the test beam effort at a Fermilab All Experimenter Meeting.

SIGNATURES:

_____/ / 2003
Marina Artuso, BTeV RICH Test Beam Spokesperson

_____/ / 2003
John Cooper, Particle Physics Division

_____/ / 2003
Roger Dixon, Beams Division

_____/ / 2003
Robert Tschirhart, Computing Division

_____/ / 2003
William Griffing, ES&H Section

_____/ / 2003
Hugh Montgomery, Associate Director for Research, Fermilab

_____/ / 2003
Steven Holmes, Associate Director for Accelerators, Fermilab

_____/ / 2003
Michael Witherell, Director, Fermilab

_____/ / 2003
Joel Butler, BTeV Co-spokesperson

_____/ / 2003
Sheldon Stone, BTeV Co-spokesperson

APPENDIX I - DAQ Infrastructure

Each HPD will be connected to individual front-end electronics hybrids. Their digital signals will be processed by mezzanine cards of Fermilab design, connected in pairs to 8 “PTA PCI cards”, of Fermilab design with firmware modified at Syracuse to be adapted to our needs. They will reside in a PCI extender box and connected with the DAQ computer. The data from the tracking chamber need to be synchronized with RICH data.

APPENDIX II - Offline Analysis Plan

DATA PROJECTION

Based on the run plan outlined on page in Appendix III, we expect at most a few tens of gigabytes of data. This will be stored on the DAQ computer through the lifetime of the test beam run. It will also be copied to computers located at Syracuse University.

ANALYSIS PLAN

Analysis will be performed using computing facilities available at Syracuse, where there are adequate resources available.

REQUEST

No offline computing resources are requested from Fermilab.

APPENDIX III - Run Plan

We will construct a working system at Syracuse University. All of the equipment necessary is already available at Syracuse except for the final C_4F_{10} recirculating system that is being prepared at Fermilab. Thus, once the MTest beam is stable we will be able to transport and install the entire RICH detector and readout system in a couple of days. We anticipate to take data for about 1 month to accomplish the specific objectives listed below.

Run Plan:

1. Goals:

The main goal of this beam test is to check that the major components of the RICH design have met specifications. While individual components may be tested on the bench, the absolute number of Cherenkov photons must be measured in the beam.

2. Specific plans:

- a. We will measure the noise rate in both HPD and MAPMT photo-sensors.
- b. We will operate both systems at full voltage and measure the number of photons on the Cherenkov rings and the ring resolution with HPD's.
- c. We will cross-calibrate the photon yields in the two MAPMT's that we have.
- d. We will compare the ring resolution with predictions and see if any of our subsystem designs need to be upgraded.

APPENDIX IV - Hazard Identification Checklist

Items for which there is anticipated need have been checked

Cryogenics		Electrical Equipment		Hazardous/Toxic Materials	
	Beam line magnets		Cryo/Electrical devices		List hazardous/toxic materials
	Analysis magnets		Capacitor banks		planned for use in a beam line or
	Target	X	high voltage (> 5 kV)		experimental enclosure:
	Bubble chamber		exposed equipment over 50 V		
Pressure Vessels		Flammable Gasses or Liquids			
	inside diameter	type:			
atm	operating pressure	flow rate:			
	Window material	capacity:			
	Window thickness	Radioactive Sources			
Vacuum Vessels			permanent installation	Target Materials	
	inside diameter		temporary use		Beryllium (Be)
	operating pressure	type:			Lithium (Li)
	window material	strength:			Mercury (Hg)
	window thickness	Hazardous Chemicals			Lead (Pb)
Lasers			Cyanide plating materials		Tungsten (W)
	Permanent installation		Scintillation Oil		Uranium (U)
	Temporary installation		PCBs		Other : Probably C/Al/Cu/Si
	Calibration		Methane	Mechanical Structures	
	Alignment		TMAE		Lifting devices
type:	Nitrogen		TEA		motion controllers
Wattage:			photographic developers	X	scaffolding/elevated platforms
class:	III	X	Other: C ₄ F ₁₀		Others